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Defines terms and discusses basic formulas of space utilization surveys. Stresses the problems of planning a building program for a large institution and cites the planning of the Riverside campus of the University of California as an example of translating a building program into architectural plans.

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# XIII. Space Utilization Surveys in Large Institutions

. . . . . Donovan E. Smith

## Definition of Terms

I do not propose here to establish definitions for the sake of standardization, but merely to explain what I mean by some of the terms--and to do so merely for the sake of clarity in this discussion.

(1) The term "space-utilization study," is so well-established with the conventional, limited meaning, "the study of the scheduled utilization of instructional rooms by organized classes," that I have given up trying to get the meaning broadened to take into account all the rest of the physical plant. I'm still searching for a term to identify a study that takes into account the various factors in the utilization of all space, not just that relatively small part that the classrooms and teaching laboratories represent. So I'll try to be conventional and, by using the word "utilization"--generally adding the word "rate"--refer to the kind of data produced by tabulating class-hours and student-hours (or, if you prefer, "student-class-hours") per week, per day, per time-of-day, and so on.

(2) "assignable square feet" is a term coming into fairly wide use as representing the interior areas that house the productive activities in a building, based on wall-to-wall dimensions within each room. Many terms have been used in the past--"net," "useful," "net useful," and "usable." (Some people have measured from center-lines of walls, although how they do this is something I've never quite been able to understand. It must be a rather messy operation to go about drilling holes in each wall in order to measure their thicknesses, to locate the center-lines.) By "Assignable square feet," then, I mean simply the measurement from the interior surfaces of walls, with no necessary connotation as to whether or not the space has been productively assigned. But note the implication that it can be so assigned--and therefore the exclusion of such general-circulation areas as corridors and stairs, such building-service areas as mechanical-equipment rooms and janitor's closets, and such areas as public toilets--and, of course, all the walls and partitions themselves.

(3) The definition of "types of rooms," is one for which I would refer you to other sources, since there is some general agreement on how these terms are used. The Manual for Studies of Space Utilization in Colleges and Universities by John Dale Russell and James I. Doi



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and Donald Jones' Physical Facilities Analysis give very adequate definitions. So if any of you are interested in a standard classification of rooms by types for a space survey, I couldn't guide you any better than could either the Russell-Doi manual or the Donald Jones book.

(4) "Scheduled utilization" is a term I've tried consistently to use when I'm speaking only of the conventional measurement--class-hours per week per room, student-hours per week per station, and percentage relationship between size of class and size of room--and I'll try here to use this limited term for this limited application if I don't use the conventional term, "space utilization."

(5) By "academic program" all I'm really talking about is a quantitative definition of a projected educational program--spelled out in terms of student-credit-hours, full-time-equivalent students, or whatever measurement the institution uses, projected numbers of staff, and other figures. There are data which "planning analysts" or architects can translate into a concrete plan (for either a concrete or steel building). Statements of philosophy, purposes, educational aims, hopes, and aspirations are certainly necessary, but they can be very frustrating to the person who has to develop a precise, written, numerical description of a building, and then translate that description into working drawings which sharply delineate the physical features that will then determine, within fairly narrow limits, what can be done by how many persons. So, by "academic program," I mean only this quantitative spelling-out of the real academic program.

## Basic Formulas

We might as well now go into some algebraic formulas. I do not propose to make this a lesson in mathematics; my purpose in presenting these formulas is merely to point out the relationships which are represented.

Basic formulas: $F = \frac{T\,S}{U}$ and $G = \frac{k\,S}{U}$,

in which F = floor area per unit quantity of academic program, e.g., ASF (assignable square feet) per 100 SCH (student-credit-hours for one semester),

T = quantity of specific type of teaching per unit quantity of academic program, e.g., SH (student-hours per week) per 100 SCH, or SH per FTE (full-time-equivalent) student,

S = space (floor area) per station for specific type of teaching, e.g., ASF per teaching-laboratory station, including floor area of related laboratory-service rooms,

U = station-utilization rate, e.g., SH per station,

G = floor area per unit quantity of specific type of teaching, e.g., ASF per 100 SH,

k = constant, e.g., 100 if G is expressed as ASF per 100 SH.

A study of the kind to which I have referred sarcastically as the conventional utilization study is one that covers only the one factor, U, the station-utilization rate in organized-class facilities--and sometimes only the room-utilization rate, which is merely one of two subfactors of this.

Most judgments of an institution's level of performance in physical-plant utilization, and most evaluations of an institution's student capacity have been based on a consideration of this single factor. Obviously, however, in a formula or algebraic equation such as this one, doubling any one of the three independent variables (T, S, or U) will change the numberical value of F by the factor of two. In other words, either doubling or halving any one of the three factors--(a) relative amount of the particular kind of organized-class instruction, (b) floor area per station, or (c) station-utilization rate--will double or halve the floor area per student, or per any student-related unit of measurement. Therefore, in an actual case--and I have seen several such cases--the floor area per student, or per FTE student, or per student-credit-hour, can be as much as eight times greater in one instance than in another.

Even such an old and well-established subject as chemistry, even freshman chemistry, can be, and is, taught with a wide variability in the amount of laboratory instruction--say, two 2-hour meetings per week, or one 3-hour, all the way to two 3-hour meetings per week, plus two or three hours of lecture--for a fairly limited range of credit values, generally. Obviously, if there is twice as much laboratory instruction for a given amount of credit in one instance, then a given amount of "production" in terms of student-credit-hours will require twice as much laboratory space as in the other instance. Similarly, if--for good or bad reasons--the one laboratory situation provides twice as much floor area per student accommodated at one time (that is, floor area per station), then that factor in itself will double the total requirement. And if there is then a two-to-one difference in the station-utilization rates, the combined effect of the three factors can be an eight-to-one difference in the two laboratory floor areas per student-credit-hour or per other student-related unit of measurement.

This was precisely the situation in a pair of cases in the California and Western Conference Cost and Statistical Study--an eight-to-one relationship between the floor areas per 100 student-credit-hours at the two ends of the scale, in the specific subject field. The one case, as compared with the other, had almost exactly twice the relative amount of laboratory instruction, almost exactly twice the floor area per

station, and--to top it off--almost precisely one-half the station-utilization rate. The resulting eight-to-one range is much greater than anyone would deduce by looking only at the station-utilization rate--or even at the floor area per station and utilization rate combined.

Conversely, there were cases in which the institution with the highest station-utilization rate in a given subject field was using considerably more floor area in teaching-laboratory facilities for a given number of student-credit-hours than was some other institution with a much lower utilization rate, because the differences in respect to the other factors far more than offset the difference in utilization rates. In such cases, if conclusions as to relative per-student floor areas were to be drawn, the utilization rate by itself would tell not only an incomplete story, but actually the wrong story.

The formula for "G" is simply the "F" formula with the teaching-method factor removed. The "G" formula is the one more commonly used. I have to confess that it represents the more direct approach, particularly for the translation of projected teaching programs into projected space requirements. I dislike it, however, because it does exclude the academic factor of the relative amount of each type of instruction, and therefore takes the existing teaching methods on faith. I think those methods are as much subject to question as are any other factor; certainly if they are not changing enough to be a factor in the physical planning, then they should be examined!

My way--the "F" formula--requires a little more arithmetic, but I feel safer that way because it requires examination of all the factors, and because it is not so likely to lead to the false inferences that the "G" formula practically invites the user to draw. I don't propose here to discuss the differences between the two formulas and their applications--basically the difference between data based on student-credit-hour measurements and those based on student-hour (or, as some people call them, student-class-hour) measurements--because that discussion usually develops into an all-day argument. In this field--physical-plant analysis--the use of student-credit-hour measurements is by no means as general as it is in many cost studies.

Some General References

I would recommend to you Nathaniel Becker's article, "Space Analysis in Architecture," which appeared in The Journal of the AIA this spring because I feel that, although the field of study concerned is industry, commerce, and government, Mr. Becker's article is an excellent description of the functions performed by persons like myself who are trying to bridge the gap between the academic program and the architectural plan in translating the words and numbers describing the one into those describing the other. I think the ideas and principles in the article are good.

I should like to comment at this point on some excerpts from my own Report on Utilization of Instructional Rooms. I must confess that this report is as guilty of concentrating exclusively on the instructional rooms as are any of the utilization studies on which I have cast aspersions in the past.

Teaching-lab Utilization by Each Department Group

Table 11 lists the station-utilization rate and its two factors--the room-utilization rate and the students-to-stations relationship--for the teaching laboratories of each of the seven principal groups of teaching-lab users at each campus. It is almost as difficult to draw sensible conclusions from these figures as from corresponding campus-wide averages, for an intelligent analysis of teaching-lab utilization requires, in many instances, an examination of the circumstances in the individual rooms and in the individual classes that can be scheduled in a given room. Nevertheless, most of these sets of three figures each--e.g., items A, B, and C in each instance--are so consistent with each other that the finding of something startlingly different in a more detailed examination seems unlikely. I suspect that the same question would still remain: "Isn't there some way that a very expensive student-station can be scheduled more than about a dozen hours per week--especially at a time of unlimited prospective enrollments and very limited prospective capital-outlay funds?" (These teaching-lab stations represent a capital investment of at least $3,000 each; and, on the five campuses covered by this report, we now schedule a total of nearly 200,000 laboratory student-hours per week. The arithmetic of doubling such a teaching program with present utilization rates is as simple as it is frightening.)

Summary of Utilization Measurements

Table 12 summarizes the principal utilization data of this report and lists the principal absolute numbers involved. To me, the most dismaying figures are those listed as items F and G for classrooms. The item-F figures for Berkeley, Los Angeles, and Davis--the average number of stations in a classroom--are essentially the same as those which I began finding at the end of World War II, in part because many of the present classrooms at those campuses are those which were then in existence. At Riverside and Santa Barbara, however, we have been able to make a completely fresh start with the hope of doing a better job of fitting the room sizes to the class sizes--first at Santa Barbara, and then at Riverside. This accounts for the fact that the classrooms at Santa Barbara average 56 stations each, as compared with 83 at Berkeley and Los Angeles, and 100 at Davis, and that the classrooms at Riverside average the still smaller number of 40 stations each. So what happens? The number of students in the classes scheduled in classrooms is no nearer the number of stations at Riverside and Santa Barbara than anywhere else!

TABLE 11

UTILIZATION OF TEACHING LABORATORIES — BY DEPARTMENT GROUPS — FALL SEMESTER, 1956

| ITEM | BERKELEY | LOS ANGELES | DAVIS | RIVERSIDE | SANTA BARBARA |
|---|---|---|---|---|---|
| AGRICULTURE | | | | | |
| A. Student-hours per week per station | 6 | 2 | 9 | -- | -- |
| B. Class-hours per week per room | 13 | 9 | 12 | -- | -- |
| C. Mean enrollment as percentage of stations[a] | 47% | 21% | 66% | -- | -- |
| ARTS | | | | | |
| A. Student-hours per week per station | 13 | 13 | 11 | -- | 7 |
| B. Class-hours per week per room | 14 | 21 | 12 | -- | 13 |
| C. Mean enrollment as percentage of stations[a] | 76% | 66% | 91% | -- | 48% |
| ENGINEERING | | | | | |
| A. Student-hours per week per station | 12 | 18 | -- | -- | -- |
| B. Class-hours per week per room | 17 | 20 | -- | -- | -- |
| C. Mean enrollment as percentage of stations[a] | 64% | 87% | -- | -- | -- |
| MISCELLANEOUS PROFESSIONS | | | | | |
| A. Student-hours per week per station | 10 | 8 | 5 | -- | 7 |
| B. Class-hours per week per room | 15 | 13 | 17 | -- | 16 |
| C. Mean enrollment as percentage of stations[a] | 65% | 59% | 32% | -- | 38% |
| BIOLOGICAL SCIENCES | | | | | |
| A. Student-hours per week per station | 13 | 11 | 11 | 6 | 15 |
| B. Class-hours per week per room | 16 | 15 | 14 | 12 | 17 |
| C. Mean enrollment as percentage of stations[a] | 83% | 68% | 71% | 49% | 74% |
| PHYSICAL SCIENCES | | | | | |
| A. Student-hours per week per station | 12 | 12 | 11 | 6 | 6 |
| B. Class-hours per week per room | 17 | 18 | 14 | 12 | 10 |
| C. Mean enrollment as percentage of stations[a] | 71% | 65% | 81% | 45% | 63% |
| SOCIAL SCIENCES | | | | | |
| A. Student-hours per week per station | 12 | 6 | -- | 2 | 9 |
| B. Class-hours per week per room | 18 | 11 | -- | 6 | 13 |
| C. Mean enrollment as percentage of stations[a] | 64% | 43% | -- | 28% | 70% |

a - Weighted by the number of class-hours scheduled in each room, and therefore not necessarily equal to the percentage relationship of item A to item B.

TABLE 12

SUMMARY OF UTILIZATION MEASUREMENTS AND RELATED DATA — FALL SEMESTER, 1956

| ITEM | BERKELEY | LOS ANGELES | DAVIS | RIVERSIDE | SANTA BARBARA |
|---|---|---|---|---|---|
| CLASSROOMS | | | | | |
| A. Student-hours per week per station | 10 | 13 | 8 | 8 | 8 |
| B. Class-hours per week per room | 25 | 29 | 27 | 21 | 17 |
| C. Mean enrollment as percentage of stations[a] | 47% | 46% | 33% | 42% | 45% |
| D. Number of rooms | 228 | 158 | 28 | 25 | 51 |
| E. Total number of stations | 19,032 | 13,150 | 2,795 | 1,006 | 2,863 |
| F. Mean number of stations | 83 | 83 | 100 | 40 | 56 |
| G. Mean number of students | 35 | 37 | 30 | 15 | 27 |
| SEMINAR ROOMS | | | | | |
| A. Student-hours per week per station | 10 | 7 | 4 | 12 | 5 |
| B. Class-hours per week per room | 17 | 15 | 7 | 17 | 11 |
| C. Mean enrollment as percentage of stations[a] | 60% | 46% | 55% | 64% | 47% |
| D. Number of rooms | 58 | 45 | 8 | 8 | 12 |
| E. Total number of stations | 1,177 | 882 | 143 | 131 | 278 |
| F. Mean number of stations | 20 | 20 | 18 | 16 | 23 |
| G. Mean number of students | 12 | 9 | 10 | 11 | 10 |
| TEACHING LABORATORIES | | | | | |
| A. Student-hours per week per station | 11 | 12 | 9 | 5 | 8 |
| B. Class-hours per week per room | 16 | 18 | 13 | 12 | 14 |
| C. Mean enrollment as percentage of stations[a] | 68% | 64% | 69% | 40% | 51% |
| D. Number of rooms | 228 | 169 | 82 | 20 | 61 |
| E. Total number of stations | 5,943 | 4,710 | 1,906 | 479 | 1,733 |
| F. Mean number of stations | 26 | 28 | 23 | 24 | 28 |
| G. Mean number of students | 19 | 19 | 17 | 10 | 17 |

a - Weighted by the number of class-hours scheduled in each room, and therefore not necessarily equal to the percentage relationship of item A to item B, or of item G to item F.

Nor can it be inferred that it is the reduction of average classroom size that has caused the reduction of average class size. The item-C figure for classrooms--the students-to-stations relationship--was once 55 per cent at, for example, Berkeley. In fact, that was the relationship in the period when Dwinelle Hall and its 80-odd classrooms were being planned on the basis that the projected sizes of the classes to be scheduled therein would average 75 per cent of the room sizes. So, again, what happened? The classrooms in Dwinelle Hall were built as planned, and the classes of the expected departments were scheduled therein, and--in the very first fall semester that the building was occupied--the class sizes in Dwinelle Hall averaged exactly 55 per cent of the room sizes! While the building was being built, the classes shrank exactly as much as we had shrunk the number of stations in the classrooms!*

At that point, I began seriously to question the theory that it made better sense to fit the sizes of the rooms to the sizes of the classes by proper physical planning than by administrative efforts to make the classes fit the rooms. I can recall no instance in which an instructional room has been built larger than was requested by the building committee, and I can recall several instances in which the capital-outlay funds would not stretch as far as had been requested. Furthermore, the building committees are, by and large, constituted of staff members who expect to teach classes in the rooms which the committee is "programming." I realize that to ask some questions is unrealistic, if not unwise, but I can't help wondering what the answer would be if someone with high administrative authority asked the question, "Why can't classes be more nearly the size that practically everyone has in mind when he serves on a committee that is planning a new building?"

In each section of table 11, the "A" item--student-hours per week per station--corresponds to the factor, U, in the "F" and "G" formulas. Those of you who have seen the chapter on normative data in the Russell and Doi Manual for Studies of Space Utilization will note that we (University of California) are "normal"--that is, teaching-laboratory utilization rates are generally in the neighborhood of 10 student-hours per week per station. And so, there is a first paragraph of dismay since these teaching-laboratory stations represent a capital investment of about $3,000 apiece. The "now" there referred to was a couple of years ago, at which time we had the 200,000 weekly laboratory student-hours. The "simple arithmetic" is completely obvious--200,000 students at the rate of 10 per station would require 20,000 stations, and 20,000 stations at $3,000 each would require $60,000,000--and that will certainly serve as the frightening estimate

*The classes shrank more, that is, than the amount by which they had been expected to shrink from their veteran-bulge size.

of what it would cost for teaching laboratories alone if we were to double our teaching program with present utilization rates.

The text preceding Table 12 mentions our concern over the great disparity between the average enrollments in the classes and the average capacities of the rooms, which is indicated in that table, and the continuation of this situation, despite efforts to correct it.

I can't say that anything has happened as a result of this report. I feel--and not unhappily--that this kind of work has to be conducted as part of a little-drops-of-water process, in the hope that some good will come from the cumulative effect of many small recognitions of logic and scattered increments of gain. I would not even refer to this report as an example of institutional research, except as the last paragraph argues the need for true institutional research on such questions as class size--not the question of what the sizes have been in the past, but of what the sizes and the teaching methods are going to be in the future. Otherwise, I'm afraid that, 20 to 40 years from now, the classrooms in which we'll then be operating will be no better suited to the instructional methods of the day than are the 20-to-40-year-old classrooms in which so many of our present classes are conducted.

Standards

I would distinguish between "Averages and Statistical Allocation" and "Individual-Room Criteria." What I'm referring to is the difference between the situations of a large institution and of a small institution, and the differences that develop as the small one grows and becomes medium-size, and then, perhaps, large. Certainly, long before one's institution reaches the scale of operation of the University of California, the point has been reached at which it is no longer possible for any one person to look at all the data representing each individual room. One is driven to the use of IBM (or, to avoid charges of favoritism, I should say "punched-card and other data-processing equipment, including electronic"). As the size of the institution increases, one is forced more and more to statistical analyses, and is less able to look at the particular circumstances of the individual situation--the individual teaching laboratory, the individual classes scheduled in that laboratory, the combinations of sections of different courses that might be scheduled in the one laboratory--the kind of detailed examination that is the only way to make real sense out of a study of teaching-laboratory utilization in particular. To toss freshman chemistry into a statistical combination with advanced organic chemistry is about like the hash that is half horse and half rabbit. A certain amount of such combining seems, however, to be inescapable at our scale of operation, although on our individual campuses--and we still have a few that could loosely be called "small"--the local planning analyst is able to prepare charts with a block for each room, subdivided horizontally and vertically so that the sizes and identities of the individual classes scheduled in the individual room each hour of each day can be examined. One can

much more intelligently analyze such cases than those in which the sheer mass of the data permits no closer examination than that of averages of groups of rooms for Monday, Wednesday, and Friday mornings and whatever other combinations one chooses to tabulate.

Similarly, in developing a preliminary building program and in analyzing a completed one--using the word "program" as an architect uses it, to mean the verbal and numerical description of a projected building--this problem of reducing the data to a manageable form and magnitude becomes a major problem at a large institution. There are so many square feet to deal with, that each individual case cannot be given separate attention.

Those of you whose institutions are still at the small or only middling-large stage--those of you who can therefore still look at the figures representing individual rooms, and can even look at a room number and visualize the actual room, including the colors of its walls--should strive to retain that personal contact as long as you can. Nourish it; keep it alive!

When I developed the standards used in A Restudy of the Needs of California in Higher Education, I still had a fairly direct, personal acquaintance with the physical circumstances of nearly all the departments on the several campuses. As nearly as I can describe the process of developing those standards, it consisted of playing around with numbers representing first approximations--sometimes out of thin air--manipulating whole sets of such numbers, somewhat as if they were simultaneous equations, until I finally had a series of statistical descriptions and evaluations that agreed with my largely subjective convictions as to the relative adequacy of the physical circumstances represented by the raw data with which I had started.

Essentially, this was a trial-and-error process of estimating per-person allocations of floor area--average square feet of each kind of room per each kind of person--which, when multiplied by the actual numbers of full-time-equivalent students and staff, would produce a computed total floor area agreeing closely with that either of a program which had been carefully developed, room by room, or of adjusted figures for an actual building. I'm not sure I could do it again!

There is no statistical substitute for direct, personal knowledge. When you do find yourself driven to the use of statistics, use them only as a notebook--a crutch supporting such personal acquaintance with real buildings and people as you are able to maintain.

What are the advantages and disadvantages of standards? Obviously, they have the advantage of enabling one to produce a quick and ready answer to the question, "How many square feet of building space will we need for such-and-such an academic program?" That's still no substitute for an itemized, detailed development of a program for the building, room by room, to house that academic program. But it is a

handy way to produce a fairly reliable answer when someone insists on an answer this very afternoon, if not this morning.

The disadvantages are several. The one I'm most conscious of is the constant danger of following too long and too slavishly a given set of standards--letting them become the inviolable guide when conditions are changing. Perhaps we've already done this at the University of California; we're due, I think, for a wholesale re-evaluation of the standards by which we've been developing our building programs. If teaching methods and educational philosophies have not yet changed so much that we need to revise the physical standards, then those methods and philosophies certainly ought to change soon.

Development of a Building Program

For an individual building, one can start with an approximation developed by a mathematical application of standards, as I described in Methods for Determining Space Needs Which Are Related to Enrollment. This should, however, only be a point of departure. We try to use such a calculation primarily to establish the total floor area to be programmed, leaving considerable freedom for the planning group and the architect to work out the details within that total, and admitting also the possibility of departing from that total if the need to do so can be demonstrated.

For an entire campus--whether for a certain "target" year several years in the future, or year by year for the next few years--one is practically driven to the use of some kind of shorthand, statistical, best-approximation procedure. One step further--an entire multi-campus institution such as we have, or as each of several states would have if all its institutions of higher education were in one system--and then one finds himself with the problem of producing an encyclopedia. The mere typographical problem of listing all the projects--of scheduling the several phases of each project's funding, year by year, and keeping track of all the dollars--becomes something for which one turns to a punched-card machine, if not an electronic brain, because a human clerk is too slow.

In a comprehensive study of an entire large state or region, one has the problems we faced in the California Restudy, and are now facing again. In such studies, one is compelled to rely almost entirely, if not completely, on statistical manipulations of broad groupings of data--gross totals and subtotals. Seldom can objective measurements be used, and all too often highly subjective replies must be given to such questions as that frequently addressed to the president of institutions, "How many more students could your institution accommodate?"

Translation of a Building Program into Architectural Plans

It may help if I close with a brief description of our one happy experience of being able to program (in the physical-planning sense), room by room, all the buildings of an entire new campus on the basis of what I refer to as an academic program--a happy experience which is so unusual that I am afraid I may never have another one, if only because of the laws of probability.

The University of California's Riverside campus was, and still is, a long-established citrus experiment station of the College of Agriculture on which a Liberal Arts College was established. Our first good fortune was the appointment of the chief administrative officer, Dr. Gordon Watkins, far, far in advance of any students and even of any firm allocation of the funds to specific projects. At that time, Dr. Watkins was serving on the Railway Labor Mediation Board, and had, therefore, to spend considerable time in Chicago. Nevertheless, he somehow found time--sitting in his room in the Palmer House with his portable typewriter, using either the touch system or the seek-and-ye-shall-find method--to type what amounted to an annotated draft of the general catalog: course descriptions, expected course enrollments, desired section sizes, types of instruction (lecture, discussion, laboratory), and number of hours per week for each section.

All this was done with a 1,500-student enrollment in mind. To my knowledge, he performed no arithmetic with the numbers he set down; we, of course, did. We multiplied each course's credit value by the projected course enrollment, added all the products, divided by the appropriate factor, and then almost fainted when the sum turned out to be 1,497 full-time-equivalent students! There were a few instances of what we on the staff felt were imbalances between subject fields. By the time we had ironed those out, the total wasn't quite so close to 1,500; but it was a remarkable performance by Dr. Watkins--one that I doubt anyone will ever be able to repeat.

Of course, there turned out to be, in fact, differences between the academic program as he laid it out and what actually developed, as well as differences between the physical provisions which we made and those which became necessary. And there are now differences between what was then projected as the ultimate size and what we are now projecting.

For example, by an administrative decision in the early planning stages, it was determined that it would not be necessary to furnish research facilities in the biological sciences building of the Liberal Arts College because the Agricultural College was so well represented by its Experiment Station, research facilities of which were presumed to be available to the biological scientists of the new college. In this same connection, it was decreed that some part--probably small but nevertheless significant--of the instruction in the biological sciences could be performed by Experiment Station personnel.

Neither of those events came to pass. Consequently, the college found itself in operation with the biological scientists not provided with research facilities corresponding to those which we had for the physical scientists in the Physical Sciences Building.

Another difference that developed was in the distribution of students among subject fields. In our planning, one of the criteria that had been laid down was that we were to plan Riverside as "Berkeley and Los Angeles in miniature." We had to translate the term, "in miniature," very loosely. Obviously, for example, there was not going to be any College of Engineering at Riverside--at least, that seemed obvious then. So we had, for example, the question, "In what subject fields are the counterparts of Berkeley's and Los Angeles' engineering students going to enroll at Riverside?" Furthermore, when we had compared Gordon Watkin's catalog with those of Berkeley and Los Angeles, we had discovered that even within our one institution we were not consistent in the course numbering at the two campuses--even, in some instances, as to whether a given course was lower- or upper-division level.

In the face of such variations, we could not carry the planning completely to a course-by-course operation. However, as roughly as we were able to approach that basis, we tended to assume that the presence of the College of Agriculture--even if only in the form of the neighboring Experiment Station--would be a stimulating factor in the biological sciences. Curiously enough, just the opposite has happened. I don't mean that the biological sciences seem to have been deterred. The students have, however, flocked in great numbers to the physical sciences. The college therefore found itself in operation with a considerably greater proportion of students--student-credit-hours, FTE students, student-hours per week, or however you would choose to measure it--in the physical sciences than anyone had expected, and therefore proportionately less somewhere else. The "somewhere else" was, however, spread throughout the rest of the college, so there was no great impact on any one subject field other than the physical sciences.

The original campus planning had been on the basis of an initial physical development for 1,500 students--a figure which we had "backed into" by roughly estimating the number of students for whom the initial appropriation of about $5,300,000 would provide physical facilities at the construction costs of the day--costs which, I'm afraid, are now so long gone that we'll never see anything even faintly resembling them again! The campus master plan was based, as I recall, on an enrollment of 3,500, but with provision for ultimate expansion to 5,000. Now, however, we're faced by the necessity of planning for at least 10,000.

Despite these differences between the plan and what developed, we found ourselves in a manageable situation. The physical inequities in such respects as research facilities, even total staff facilities, have been corrected in the first series of added buildings. Some of the

Riverside people would not agree, I'm sure. But it's my conviction that we didn't fail completely. The Riverside campus not only has survived; it has, in fact, established an outstandingly fine record for an institution in its first few years of operation--fine, that is, in such terms as the percentage of graduates that have gone on into graduate work. Any mistakes we made in the physical planning could not, therefore, have been exactly fatal.

As for the campus plan itself, Mr. Evans may have time to discuss it in his lecture. He and I feel that we have a soluble problem in adapting it from a goal of 3,500 to 5,000 students to one of at least 10,000. An obvious question is, of course, the one, "How can the original plan still be workable when so many features of the college have changed?" To some extent, the answer I would give is a retraction of statements that some of you have heard me make in the past. Right now, I would attribute whatever success we've had in making physical adaptations to the fact that the original architectural planning, while admittedly not perfect, provided a high degree of flexibility and extensibility--particularly in the campus plan--to accommodate developments far beyond anything that was foreseen, or even foreseeable, by those who were doing the academic and physical planning. This was done in ways which I assume Mr. Evans will discuss this afternoon!